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Patentanmeldung Nr. Patent application No. Demande de brevet n°

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Method for fast reconstruction of content information

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Method for fast reconstruction of content information

The present invention relates to a method for the fast reconstruction of content information of a recording medium, and to an apparatus for reading from and/or writing to recording media using such method.

Nowadays multi-format players for optical disks support optical disks with multimedia data content. Supported data file types range from MP3 audio files via JPEG photos to MPEG4 video clips. The files are usually stored in a file system on the optical disk in a format designed for optical data retrieval. Each time an optical disk is inserted in the player, the device initially reconstructs content information, e.g. the file system, and possibly establishes a database before being able to access the multimedia files. Such a reconstruction of the content information and/or an establishment of a database is also needed in other circumstances, e.g. in a disk changer in which one of a plurality of disks is selected and transferred into a playback position, or when a portable player wakes up from a power down mode.

The time it takes to reconstruct the content information depends, to a large extent, on the number of files on the recording medium, i.e. in the file system. The larger the number of files, the longer it takes to reconstruct the content information. Reducing this time duration is very convenient for a user.

US 6,034,925 discloses a method for identifying the content of a recording medium, whereby a characteristic profile of the medium is determined and compared with a plurality of profiles stored in a local or a remote database. In the database a content index comprising title and artist information is stored together with the corresponding profile. This content index is used when the profile of the specific medium is found in the

database. The title and artist information is then displayed during playback of the content.

It is an object of the invention to provide a method for the fast reconstruction of content information of a recording medium.

According to a first aspect of the invention this object is achieved by a method for reconstructing content information of a recording medium comprising the steps of:
- determining a signature of the recording medium, the signature comprising a plurality of elements;
- comparing the signature with a plurality of signatures stored in a content database; and
- retrieving associated content information from the content database if the signature matches a signature stored in the content database.

Preferably the content information is a file system, which contains the position of the content on the recording medium. The method checks whether the specific recording medium has been encountered recently in a playback device. For this purpose a signature of the recording medium is determined, which is a feature vector defined in such a way that it provides a robust unique identifier for the recording medium. The signature is able to discriminate between recording media having only minor differences in data content. The signature is compared with signatures in a database. Only if the same physical recording medium with the same content (file-system) is present, a match is found. In the prior art, in contrast, different physical recording media with the same content do all result in the same match. If a match is found a file system associated with the stored signature is retrieved from the database and used for the current recording medium. This increases the start-up speed dramatically when a recording medium is inserted into a playback or recording device,

provided that the recording medium has recently been inserted into the device.

Favourably, the step of comparing the signature with a plurality of signatures stored in a content database comprises evaluating the mathematical or logical distances between the determined signature and the signatures stored in the content database. If a distance with a value of zero is encountered, this is considered as a match. If, on the other hand, no distance with a value of zero is encountered, the system considers that no match exists in the files system database.

According to another aspect of the invention a method for reconstructing content information of a recording medium comprises the steps of:
- determining a first part of a signature of the recording medium, the signature comprising a plurality of elements;
- comparing the first part of the signature with a corresponding part of a plurality of signatures stored in a content database;
- determining a further part of the signature of the recording medium if the first part of the signature matches at least one signature stored in the content database;
- comparing the further part of the signature with a corresponding part of the plurality of signatures stored in the content database; and
- retrieving an associated file system from the content database if the signature matches a signature stored in the content database.

In this approach a hierarchical structure is employed. The order of the elements of the signature is arranged in such way that the first *m* elements are evaluated quickly, while the further elements may take a longer time to determine. This allows a very fast determination whether a recording medium has not yet been stored in the content database. Only if the first *m* elements do not allow to exclude that a recording medium has

previously been encountered, the further elements are considered.

Advantageously, in the comparing steps a negative progressive search approach is employed, in which the elements of the determined signature are compared with the corresponding elements of the signatures stored in the content database one at a time, wherein of every element of the signature may yield a negative search result.
The elements of the signature are defined such that if a "No Match" between an element in the signature and the same element of all the signatures in the signature list is encountered, then a "No Match" is concluded categorically. This speeds up the process as the further elements do no longer need to be considered.

Favourably, the method further comprises the steps of:
- reconstructing the content information from the recording medium if the determined signature does not match a signature stored in the content database; and
- storing the reconstructed content information and the determined signature in the content database.
The solution described above with reference to the prior art requires a manual intervention by a user to add artist and title information to a database. Under the same situation, the method according to the invention generates the file system automatically and adds it to the database together with the associated signature.

Advantageously, an apparatus for reading from and/or writing to recording media uses a method according to the invention for reconstructing content information of the recording medium. Such an apparatus is very convenient for a user since the start-up procedure needs less time if the recording medium has previously been inserted in the apparatus.

Favourably, the apparatus performs the reconstruction of the content information of the recording medium after insertion o the recording medium, after transferral of the recording medi into a playback position, or after wake up from a power down mode. These are the main situations in which a reconstruction of the content information becomes necessary.

For a better understanding of the invention, an exemplary embodiment is specified in the following description with reference to the figures. It is understood that the invention is not limited to this exemplary embodiment and that specifie features can also expediently be combined and/or modified without departing from the scope of the present invention. In the figures:

Fig. 1 shows a method according to the invention for the fast reconstruction of a file system of a recordin medium;

Fig. 2 shows a general structure of a file system databas

Fig. 3 schematically shows a first query of the file syst database for a matching signature; and

Fig. 4 schematically shows a second query of the file system database for a matching signature.

In Fig. 1 a method according to the invention for the fast reconstruction of the content information 11 of a recording medium inserted into an apparatus for reading from and/or writing to recording media is shown. In the following the invention is explained for optical disks. However, the invention is also applicable to other types of recording media. Furthermore, reference is made to a file system as an example for content information.

When in a step 1 a disk is inserted into a loader of an optical playback and/or recording device, either manually for a single disk device or through the selection mechanism of a disk changer, in a step 2 a signature <S> 10 is generated. The signature 10 has the form of a feature vector, so that,

$$<S> = \{s(1), s(2), s(3), \ldots, s(n)\}.$$

Each element in the feature vector $\{s(1), s(2), s(3), \ldots, s(n)\}$ is a single measurement of a feature based on the pattern of the data content on the disk.

The signature 10 is then compared in a step 3 with a signature list in a file system database of the playback and/or recording device. Each signature in the list is associated to a file system 11, as shown in Fig. 2. The file system database is preferably stored in a non-volatile memory.

If in the next step 4 no matching signature 10 is found, the file system 11 of the disk is reconstructed 7 from the data retrieved from the disk. This new file system 11 and the associated signature 10 are then added 8 to the file system database. On the other hand, if in the step 4 a match is found, the file system 11, which is associated to the matching signature 10, is retrieved from the file system database and used as the file system 11 of the disk. In both cases the procedure ends 6 when the complete file system 11 has been retrieved.

Fig. 2 shows the general structure of a file system database. Each signature 10 in the file system database is associated to the corresponding file system 11.

The signature feature vector 10 is defined in such a way that it provides a robust unique identifier for a disk. Furthermore, it should be able to discriminate between disks having only

minor differences in data content. Preferably the signature 10 also handles multi-session disks and uses features, which can be measured accurately and quickly. In order to perform the determination of the signature and the comparison with the file system database within a reasonable time, the length of the feature vector preferably is moderate.

Possible elements for the determining the feature vector comprise:

Disk Status:

- Open/Closed disk
- Number of sessions
- Number of tracks in each session

Timing information:

- Lead-in time of each session
- Lead-out time of each session
- Q-Code information of each data track shown in the table of content
- Total time of each session calculated from the timing information in the table of content

Data integrity:

- Data checksums of specific track

Preferably the data checksum of the last track on the disk is analysed. The data checksum of the specific track is the arithmetic sum of a pre-defined area inside the data track. Depending on the implementation of the method, the pre-defined area is the beginning, the middle or the end of the track. The size of the area is one sector or more. The checksum preferably is 16 bit or 32 bit.

Of course, other features of the recording media can also be used for determining the feature vector.

Different approaches exist for querying if the input signature <S> matches one of the signatures 10 inside the File System Database.

Fig. 3 schematically shows a first approach for querying the file system database for a matching signature. In a step 2 the signature <S> is constructed by evaluating the different feature vector elements. The distances between the signature vector <S> and each of the signatures 10 in the signature list of the file system database are then evaluated 31. If in a step 4 a distance with a value of zero is encountered, this is considered as a match 41. If, on the other hand, no distance with a value of zero is encountered in the step 4, the system considers 42 that no match exists in the files system database.

Another possible approach for querying the file system database for a matching signature is shown in Fig. 4. A hierarchical structure is employed in this approach. The order of the feature vector elements of the signature <S> is arranged so that the first m elements are evaluated quickly, while the elements from $m+1$ to n may take a longer time to determine. All elements are defined such that if there is one "No Match" between an element in the signature <S> and the same element of all the signatures 10 in the signature list, then a "No Match" is concluded categorically 42. Elements 1 to m of <S> are determined first 21, then a query for a match is performed one element at a time 43, 44. On the other hand, for the elements $m+1$ to n, each element is determined separately 22, 23 and queried for a match immediately 45, 46. If a signature 10 is found in the signature list, which is equal to the determined signature in all elements, this signature is considered 41 a match.

Claims

1. Method for reconstructing content information of a recording medium, comprising the steps of:
- determining (2) a signature (<S>) of the recording medium, the signature comprising a plurality of elements;
- comparing (3, 4) the signature (<S>) with a plurality of signatures (10) stored in a content database; and
- retrieving (5) associated content information from the content database if the signature (<S>) matches a signature (10) stored in the content database.

2. Method according to claim 1, characterized in that the step of comparing (3, 4) the signature (<S>) with a plurality of signatures (10) stored in a content database comprises evaluating (31) the distances between the determined signature (<S>) and the signatures (10) stored in the content database.

3. Method for reconstructing content information of a recording medium, comprising the steps of:
- determining (21) a first part of a signature (<S>) of the recording medium, the signature (<S>) comprising a plurality c elements (s(1), s(2), s(3),...,s(n));
- comparing (43, 44) the first part of the signature (<S>) wit a corresponding part of a plurality of signatures (10) stored in a content database;
- determining (22, 23) a further part of the signature (<S>) o the recording medium if the first part of the signature (<S>) matches at least one signature (10) stored in the content database;
- comparing (45, 46) the further part of the signature (<S>) with a corresponding part of the plurality of signatures (10) stored in the content database; and

- retrieving (5) an associated file system from the content database if the signature (<S>) matches a signature (10) stored in the content database.

4. Method according to one of claims 1 to 3, characterized in that in the comparing steps (3, 4, 43, 44, 45, 46) a negative progressive search approach is employed, in which the elements of the determined signature (<S>) are compared with the corresponding elements of the signatures (10) stored in the content database one at a time, wherein every element of the signature (<S>) may yield a negative search result.

5. Method according to one of claims 1 to 4, further comprising the steps of:
- reconstructing (7) the content information from the recording medium if the determined signature (<S>) does not match a signature (10) stored in the content database; and
- storing (8) the reconstructed content information and the determined signature (<S>) in the content database.

6. Method according to one of claims 1 to 5, characterized in that the signature (<S>) is unique for every recording medium.

7. Method according to one of claims 1 to 6, characterized in that the content information is a file system.

8. Method according to one of claims 1 to 7, wherein the signature elements are selected from the disk status such as open or closed disk, number of sessions or number of tracks in each session, from timing information such as the lead-in time of each session, the lead-out time of each session, the total time of each session or subcode information of each track, or from data integrity such as data checksums of specific tracks.

9. Apparatus for reading from and/or writing to recording media, characterized in that it uses a method according to

anyone of claims 1 to 8 for reconstructing content information of the recording medium.

10. Apparatus according to claim 9, characterized in that it performs the reconstruction of the content information of the recording medium after insertion of the recording medium, after transferral of the recording medium into a playback position, or after wake up from a power down mode.

Abstract

Method for fast reconstruction of content information

The present invention relates to a method for the fast reconstruction of content information of a recording medium. According to the invention, the method comprises the steps of:
- determining 2 a signature <S> of the recording medium, the signature comprising a plurality of elements;
- comparing 3, 4 the signature <S> with a plurality of signatures 10 stored in a content database; and
- retrieving 5 associated content information from the content database if the signature <S> matches a signature 10 stored in the content database.

Fig. 1

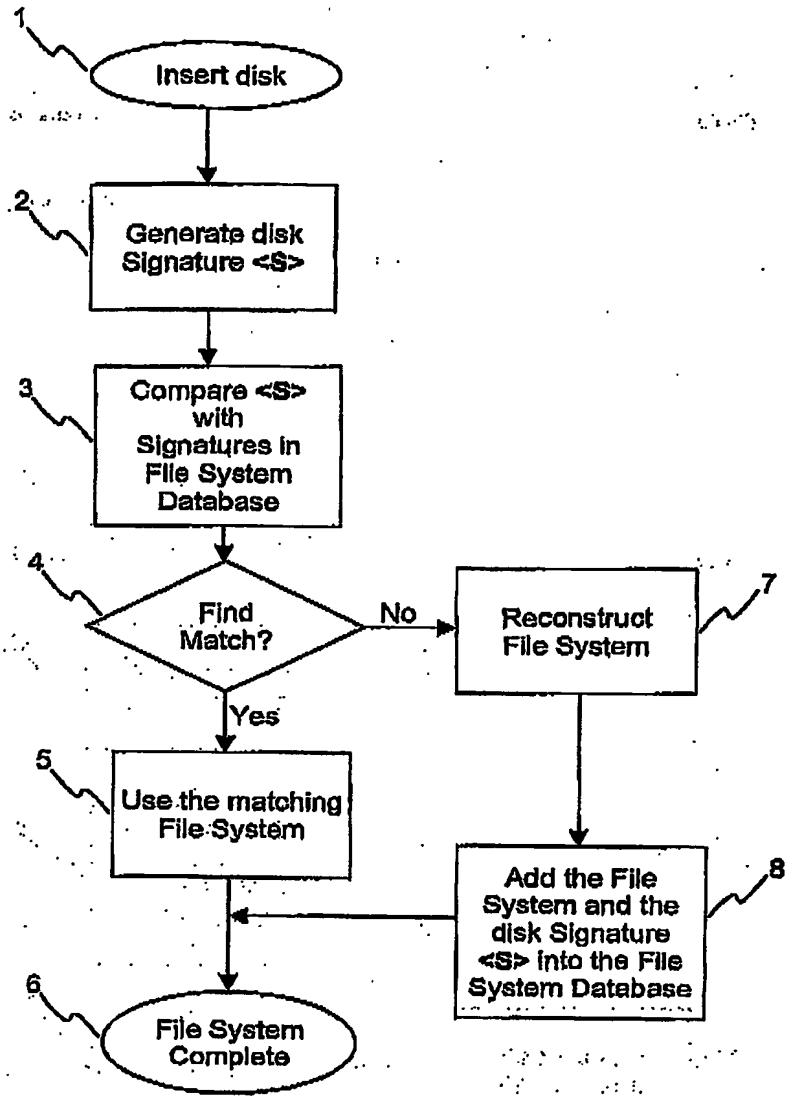
1
Insert disk
2
Generate disk Signature <S>
3
Compare <S> with Signatures in File System Database
4
Find Match?
No
7
Reconstruct File System
Yes
5
Use the matching File System
8
Add the File System and the disk Signature <S> into the File System Database
6
File System Complete

Fig. 1

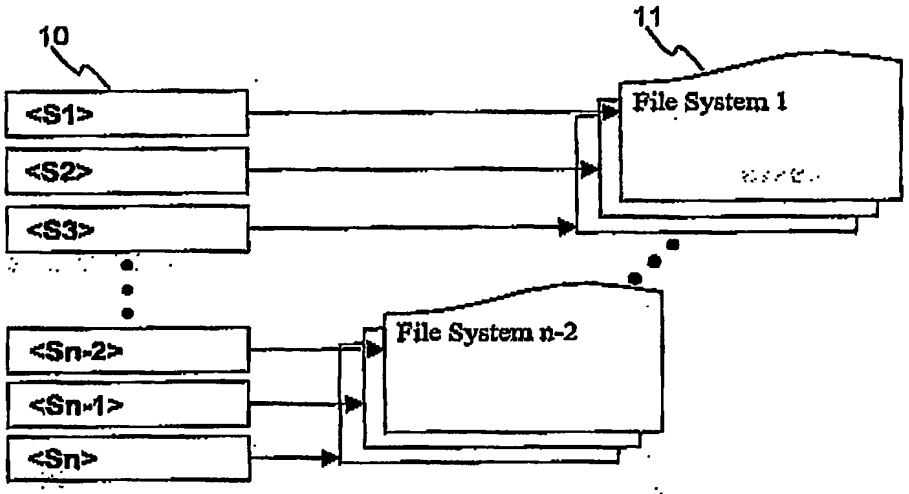
10
11
<S1>
<S2>
<S3>
<Sn-2>
<Sn-1>
<Sn>
File System 1
File System n-2

Fig. 2

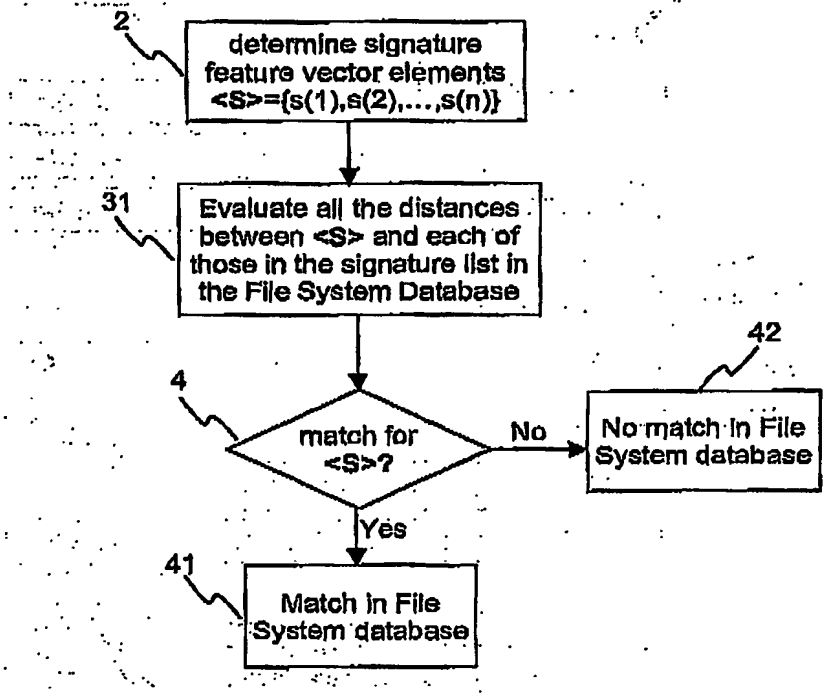
2
determine signature feature vector elements <S>={s(1),s(2),...,s(n)}
31
Evaluate all the distances between <S> and each of those in the signature list in the File System Database
4
match for <S>?
No
42
No match in File System database
Yes
41
Match in File System database

Fig. 3

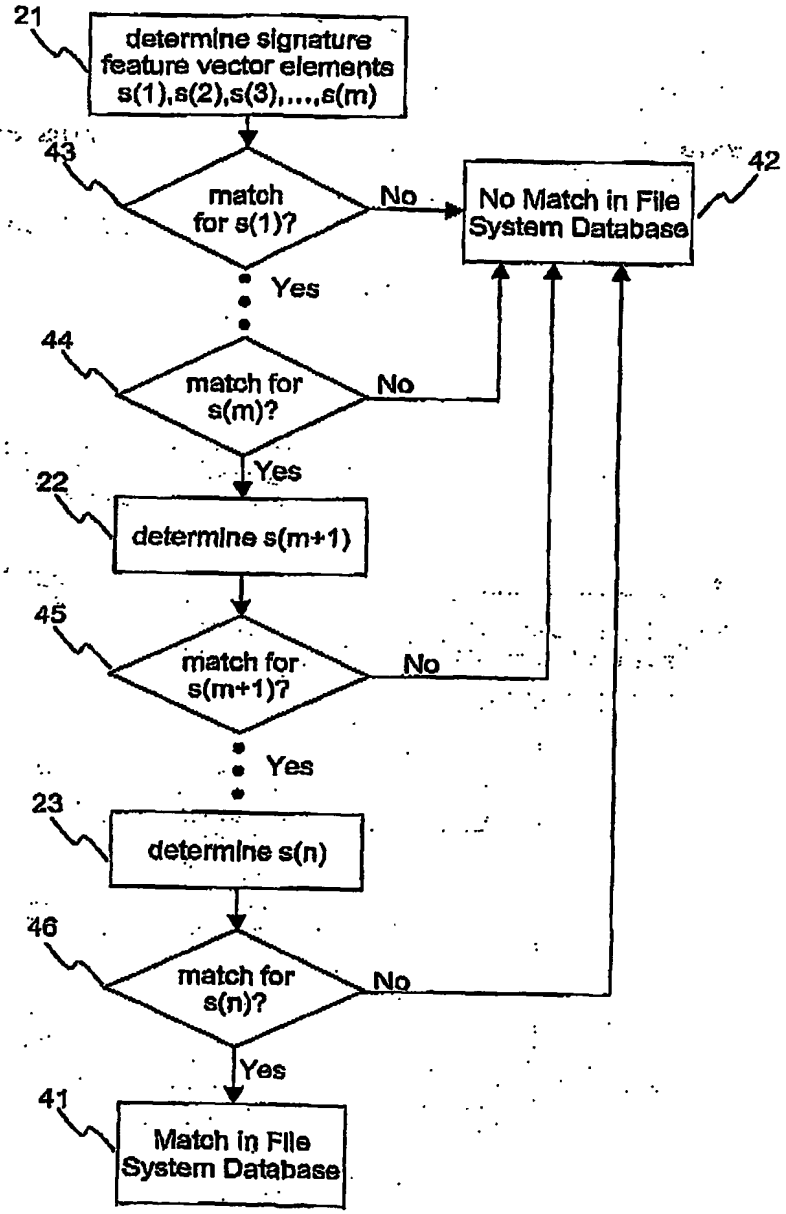
21
determine signature feature vector elements s(1),s(2),s(3),...,s(m)
43
match for s(1)?
No
42
No Match in File System Database
Yes
44
match for s(m)?
No
Yes
22
determine s(m+1)
45
match for s(m+1)?
No
Yes
23
determine s(n)
46
match for s(n)?
No
Yes
41
Match in File System Database

Fig. 4

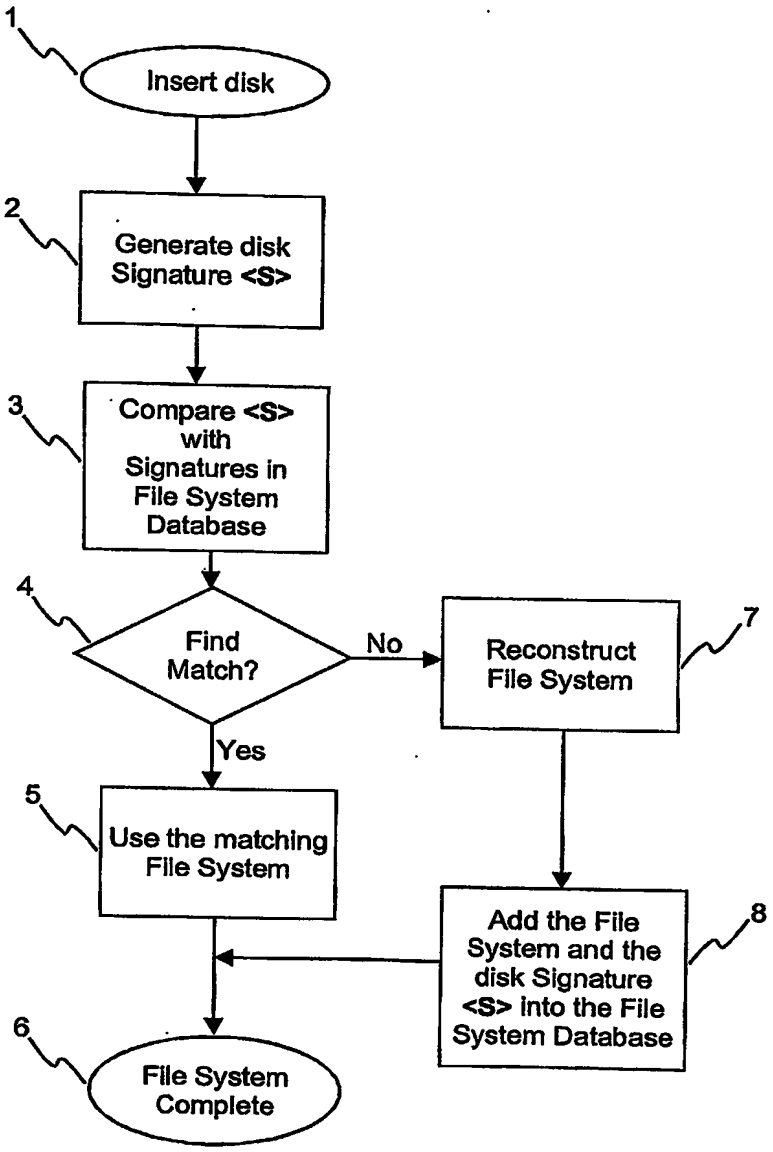

Fig. 1

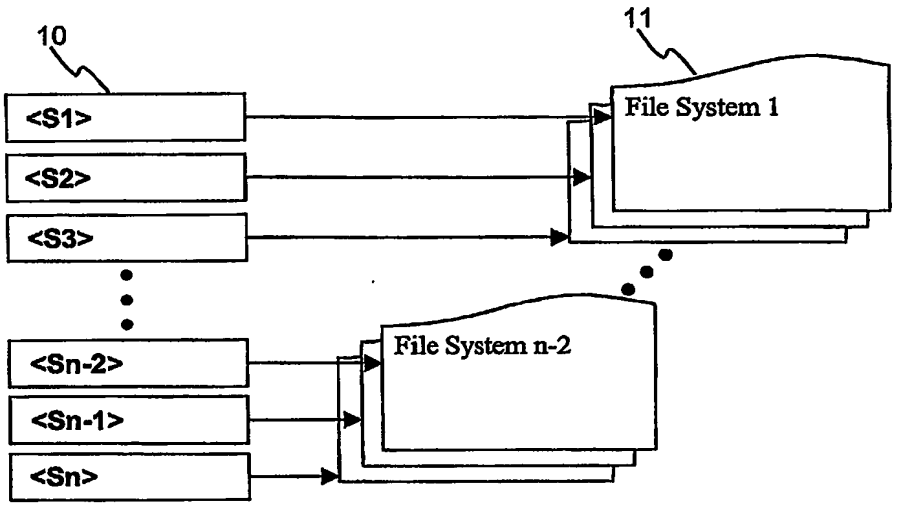
10
11
<S1>
<S2>
<S3>
<Sn-2>
<Sn-1>
<Sn>
File System 1
File System n-2

Fig. 2

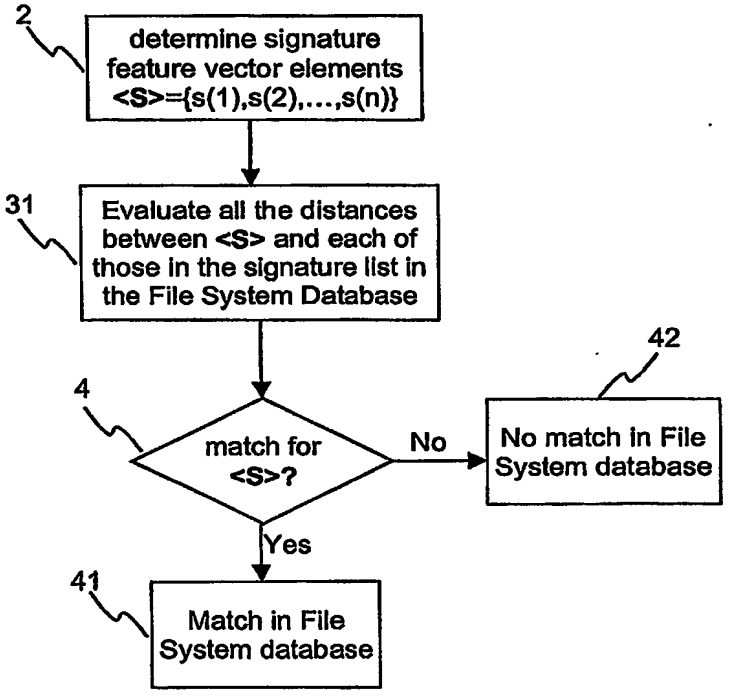
2
determine signature feature vector elements <S>={s(1),s(2),...,s(n)}
31
Evaluate all the distances between <S> and each of those in the signature list in the File System Database
4
match for <S>?
No
42
No match in File System database
Yes
41
Match in File System database

Fig. 3

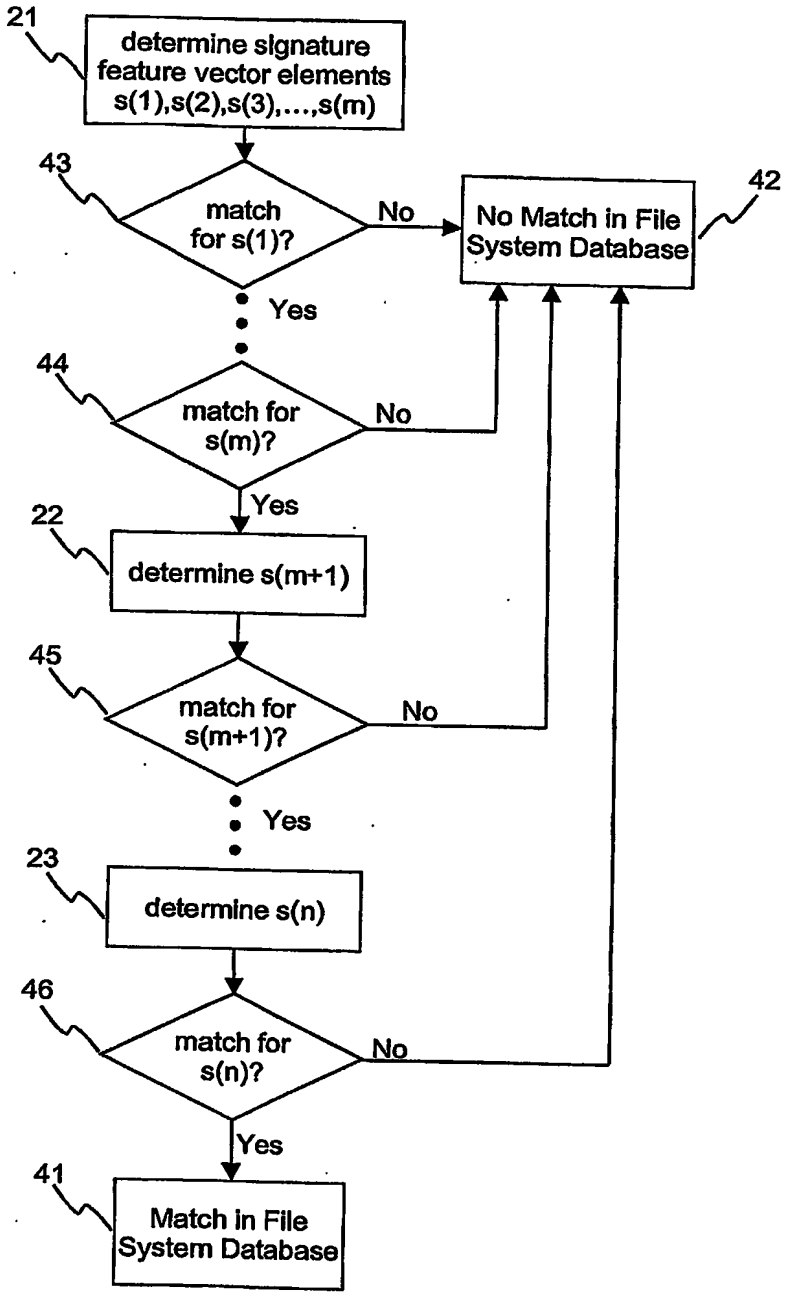
21
determine signature feature vector elements s(1),s(2),s(3),...,s(m)
43
match for s(1)?
No
42
No Match in File System Database
Yes
44
match for s(m)?
No
Yes
22
determine s(m+1)
45
match for s(m+1)?
No
Yes
23
determine s(n)
46
match for s(n)?
No
Yes
41
Match in File System Database

Fig. 4

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